

# A revision of the north-west European species of the *formosus* species group of *Spilomicrus* (Hymenoptera, Diapriidae)

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**Synopsis.** A revision of north-west European species of the *formosus* species group of *Spilomicrus* is given including an outline of the characters of the group, a key to all species and descriptions of all species. *S. crassiclavis* is removed from synonymy with *S. integer*. *S. pelion* is placed in synonymy with *S. crassiclavis*. Lectotype designations are made for *S. crassiclavis* and *S. formosus*. *S. sanbornei* is recorded as new to the Palaearctic and *S. crassiclavis* and *S. formosus* as new to the east Palaearctic.

## INTRODUCTION

The *formosus* group of *Spilomicrus* is a small species group of inconspicuous diapriid parasitoid wasps with seven described species from the Palaearctic and Nearctic regions. The group may distinguished from other *Spilomicrus* by the unusual form of the clypeus, which protrudes in front of the mandibles as a triangular or rounded projection and by associated modifications of the face (Figs 2–3, 5–6). Some members of this group have an unusual way of life as pseudohyperparasitoids of cicadellid bugs via the puparia of pipunculid flies. The *formosus* group is also significant because, although only a small group, it includes two species, *S. formosus* and *S. sanbornei*, with Holarctic distributions. It is becoming clear that such distributions are not uncommon among Diapriinae; examples are known within other species

groups of *Spilomicrus*, e.g. *S. antennatus* (Jurine) and *S. stigmatalis* Westwood (Masner, 1991) as well as species belonging to a number of other diapriine genera.

The aim of this paper is to revise the *formosus* species group of *Spilomicrus* occurring in north-west Europe. A revision was needed because of the confusion over species resulting from the mixed and partly lost type series of *S. crassiclavis* and from later misidentifications. Type material of all species was examined and type restrictions made where necessary. Nomenclatural changes were made as follows: lectotype designations were made for *S. formosus* and *S. crassiclavis*; *S. crassiclavis* was removed from synonymy with *S. integer*; *S. pelion* was placed in synonymy with *S. crassiclavis*. Currently three species are recognised in the region and, since previous keys are now inadequate, a new partial key to *Spilomicrus* is presented here. *S. crassiclavis* is recorded as new to Czechia, Denmark, Finland, Japan,

Norway and Sweden and *S. formosus* as new to Belgium, Ireland, Japan and Norway. *S. sanbornei* is recorded as new to Britain and the Palaearctic.

Morphological terminology largely follows Masner (1991). Wing vein terminology follows the convention of Mason (1986).

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## DEPOSITORIES

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BMNH	The Natural History Museum, London, United Kingdom (formerly the British Museum, Natural History)
CNC	Canadian National Collection of Insects, Arachnids and Nematodes, Ottawa, Canada
DN	D. G. Notton collection, Reading, United Kingdom
NMS	National Museums of Scotland, Edinburgh, United Kingdom
RAS	Russian Academy of Sciences, Palaeontological Institute, Arthropod Laboratory, Moscow, Russia
SEL	Department of Applied Zoology, University of Helsinki, Helsinki, Finland
ZI	Universitets Zoologiska Institutionen, Lund, Sweden
ZM	Zoological Museum, University of Copenhagen, Copenhagen, Denmark

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## SPILOMICRUS WESTWOOD

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*Spilomicrus* Westwood, 1832: 129. Type species: *Spilomicrus stigmatalis* Westwood by monotypy. Extensive generic synonymy may be found in Masner (1991) and Johnson (1992).

**DIAGNOSIS** (north-west European species only). Antenna 13-segmented in both sexes; for the female, apical antennal segment subequal to the preapical; for the male the fourth antennal segment usually modified; lateral surface of pronotum without a row of foveae; scutellum with two anterior pits, sometimes faint in some females of *S. antennatus*; macropterous to apterous; winged forms with costal cell wide, 2–3 times width of submarginal vein and

marginal vein short, not more than twice length of stigmal vein; anterior margin of metasomal sytergite (2+3) entire, and without keels, ridges or grooves, fitting loosely over apex of petiole and more or less hiding it; female with apex of gaster blunt to moderately conical.

**DISTRIBUTION.** *Spilomicrus* is a worldwide genus with many species: Johnson includes 144 described species in his World catalogue and there are many more undescribed. The number of species in north-west Europe is unclear: Nixon (1980) recorded 14 in Britain and Kozlov (1978) 22 in Europe, however there is no recent authoritative treatment covering north-west Europe. Of the four species groups recognised by Masner (1991) only the *stigmatalis* group and the *formosus* group have been found in north-west Europe, where they are both widely distributed.

**BIOLOGY.** *Spilomicrus* species have been recorded mostly as solitary endoparasitoids of the puparia of Diptera, including the host families Tephritidae, Tachinidae and possibly Bibionidae (Hoffmeister, 1989); Syrphidae, Pipunculidae, Muscidae, Sciomyzidae (Masner, 1991); Phoridae (Disney, 1994). A small number of species have been reared from the pupae (not larvae) of Staphylinidae (Coleoptera) (Nixon, 1980; Masner, 1991; Notton, 1996). Hoffmeister (1989) gives an account of the laboratory culture of *Spilomicrus hemipterus* Marshall on a species of *Drosophila* (Diptera, Drosophilidae) including descriptions of larval morphology. *Spilomicrus* species occur mainly in forest habitats although some may be common in grassland or wetland.

**COMMENTS.** North-west European *Spilomicrus* may be recognised using the generic key of Nixon (1980). The taxonomy of *Spilomicrus* on a world scale is poorly understood as are the interrelationships of its major species groups. Within north-west Europe many types need to be located and reinterpreted and a number of disparate regional studies need to be reconciled (see refs. in Masner, 1991 and Johnson, 1992). The species groups recognised by Masner (1991) are admittedly only provisional but are practical working groups: in particular the *formosus* group is easily recognisable in north-west Europe from the form of the clypeus (see key below).

### *formosus* species group: Masner

(Figs 2–20)

*formosus* species group of *Spilomicrus*: Masner, 1991: 111.

**DESCRIPTION.** Habitus robust. Head in dorsal view transverse, 1.1–1.4× as wide as long; surface of head with scattered, long, semidecumbent hairs; occipital

flange narrow but distinct, not foveolate medially; head in frontal view subcircular, slightly transverse; space between anterior margins of toruli without a carina; face just below toruli smooth, without punctures; clypeal margin medially with a ventrally directed, triangular or rounded projection, either side of this projection the clypeal margin is strongly impressed forming two deep concavities; tentorial pits absent; malar sulcus complete, strongly curved. Antenna: scape smooth and shining at least in part, if sculptured then no more than weakly coriaceous; female antenna with 5- to 8-segmented club; male antenna with segment 3 equal to or a little shorter than segment 4, segment 4 cylindrical to weakly expanded apically with a weak to moderately deep emargination and carina or flange in basal 0.3–0.7. Mandibles stout, with upper tooth short, about 0.5–0.6 of length of the lower. Mesosoma: pronotum without epomia, weakly concave between the projecting pronotal shoulder and spiracle, anteriorly with long, scattered grey hairs which do not form a distinct cushion, posteriorly with a narrow strip of short, fine hairs extending downwards from the spiracle; acetabular carina complete, extending from the lower corner of the pronotum to the mid-line of the mesosternum; transscutal sulcus weakly curved; anterior scutellar pits large, deep, rounded, 0.35–0.4 of length of scutellum, separated by a narrow medial carina, which broadens out posteriorly into the scutellar disc; lateral scutellar pits broad, deep, broadened posteriorly; 7–12 distinct, posterior, scutellar pits; medial propodeal keel low posteriorly, its highest point anteriorly well below level of mesoscutum. Fore wing with subcostal, marginal and stigmal veins tubular; costal, basal, cubital and radial sector veins nebulous; costal cell broad, at widest point at least 2.5× as wide as subcostal vein; marginal vein short, thick, about 1.7–3.0× as long as wide when its length is measured from the start of its basal expansion to the fork of the postmarginal and stigmal veins, and its width measured at the mid-point of this length; stigmal vein short to very short; radial area indicated by distal abscissa of radial sector and anterior wing margin long, extending 0.45–0.60 of distance between marginal vein and wing tip. Legs unremarkable; tarsal segments slender; basitarsi longer than telotarsi. Metasoma with dorsally visible part of petiole relatively short, 1.2–2.2× as long as wide, a little flared anteriorly, sparsely hairy at base; tergites 4–7 with scattered micropunctures and scattered hairs; sternites 3–6 (♀) or 3–7 (♂) with deep, fine micropunctures. Ovipositor sheaths and apical sternite without pegs or dense pilosity. Colour: body mainly black; fore wing weakly tinged brown, without maculae.

**DISTRIBUTION.** The *formosus* group is widely distributed throughout the Nearctic, Palaearctic, Oriental and Australian regions (Masner, 1991) although only

seven species are described so far from the Palaearctic and Nearctic. Currently three species are recognised from north-west Europe. A number of species are widespread: *S. formosus* is known to be Holarctic (Masner, 1991) and *S. sanbornei* was found to be so in the current study.

**BIOLOGY.** The only published host record for the *formosus* group (Masner, 1991) is for *S. formosus* itself: much reared material of this species was also seen during this study and supported Masner's observation that it attacks the puparia of *Pipunculus* species (Diptera, Pipunculidae) in Europe. It is therefore a pseudohyperparasitoid of cicadellid bugs (the primary hosts of *Pipunculus* species – Coe, 1966). Curiously *Spilomicrus formosus* and *S. crassiclavis* show a number of morphological similarities with some diapriines of the genus *Basalys* including *B. fumipennis*, *B. tuberculatus* and *B. erythropus* which also attack pipunculid puparia (Lundbeck, 1922; this study). These similarities include: a compact, robust habitus, transverse head and a short mesosoma with domed mesoscutum. It is speculated that this apparent convergence has resulted from independent adaptation to development inside the short ovoid puparia of pipunculids.

**COMMENTS.** The *formosus* group was recognised by Masner (1991) who defined the group by the possession of the following putative apomorphies: presence of malar sulci; a pointed clypeus; mandibles with the lower tooth stronger than the upper. On the basis of species included by Masner, the group is difficult to define because of a number of exceptions to the above characters: malar sulci do not occur throughout the *formosus* group and occur in some other *Spilomicrus* and other Spilomicrini such as *Idiotypa*; when viewed from in front, the clypeus is not pointed in all *formosus* group species, although clearly pointed in *S. formosus*, it is rounded in a number of species including *S. sanbornei*; lastly, while the mandibles do have the lower tooth stronger in the *formosus* group, this can occur in other *Spilomicrus*. Thus none of the three characters given by Masner uniquely defines the *formosus* group, however, from material seen during this study and from Masner's descriptions, this group may still be defined by a character of the clypeus, that is, in all species the clypeus protrudes well over the mandibles as a pointed or rounded projection. In addition to the malar sulcus and mandible characters noted by Masner, other supporting characters which occur frequently though not universally in this species group include: absence or reduction of tentorial pits; absence of the epistomal suture; moderately to strongly impressed clypeal margin either side of the medial projection; weakly marked dorsal margin of the clypeus so that in lateral view the surface of the face forms an even curve.

**Key to north-west European species of the *formosus* species group of *Spilomicrus***

- 1 Clypeus not protruding over mandibles (Fig. 1); clypeal margin not strongly impressed submedially; malar sulcus usually absent; tentorial pits usually present ..... *Spilomicrus stigmatalis* group
- Clypeus protruding over mandibles as a pointed or rounded projection (Figs 2, 3, 5, 6); clypeal margin strongly impressed submedially; malar sulcus present and strong; tentorial pits absent ..... (*Spilomicrus formosus* group) 2
- 2 Antennal flagellum apically clubbed (Figs 7, 10, 13); post-petiole with 6 sternites ..... (females) 3
- Antennal flagellum not clubbed (Figs 9, 12, 15); post-petiole with 7 sternites ..... (males) 5
- 3 Antennal club 5- to sub-6-segmented (Fig. 13); in frontal view, apex of medial projection of clypeus rounded, blunt (Fig. 5); mesosoma depressed, no more than 0.8x as high as wide, mesoscutum weakly convex (Fig. 16); medial propodeal keel low, hardly raised in front (Fig. 16); body length 1.9–2.5 mm ..... *sanbornei*
- Antennal club 7- to 8-segmented (Figs 7, 10); in frontal view, apex of medial projection of clypeus triangular, pointed (Figs 2–3); mesosoma less depressed, at least 0.9x as high as wide, mesoscutum strongly convex (Fig. 18); medial propodeal keel raised in front to form a right-angled to acute projection (Fig. 18); body length 2.2–3.1 mm ..... 4
- 4 Antennal club 7-segmented, with segments 8–12 strongly transverse (Fig. 7); notauli convergent anteriorly, extending over no more than basal 0.25 of mesoscutum (Fig. 19); eye height 1.4–1.5x as long as malar space (Fig. 2) ..... *crassiclavis*
- Antennal club 8-segmented, with segments 8–12 quadrate to slightly elongate (Fig. 10); notauli divergent anteriorly, extending over at least basal 0.35 of mesoscutum (Fig. 20); eye height 1.7–2.2x as long as malar space (Fig. 3) ..... *formosus*
- 5 In frontal view, apex of medial projection of clypeus rounded, blunt (cf. ♀ – Fig. 5); antennomere 4 with a moderately deep, curved emargination over basal 0.45–0.5 (Fig. 14); mesosoma depressed, no more than 0.8x as high as wide (cf. ♀ – Fig. 16); medial propodeal keel low, hardly raised in front (cf. ♀ – Fig. 16); body length 2.0–2.3 mm ..... *sanbornei*
- In frontal view, apex of medial projection of clypeus triangular, pointed (cf. ♀ ♀ – Figs 2–3); antennomere 4 with at most a shallow emargination, over basal 0.3–0.7 (Figs 8, 11); mesosoma less depressed, at least 0.9x as high as wide (Fig. 17); medial propodeal keel raised in front to form a right-angled to acute projection (Fig. 17); body length 2.1–3.7 mm ..... 6
- 6 Mesopleuron with a sternaulus, delimited dorsally by a sharp carina (Fig. 17); apical antennomere no longer than

- preapical (Fig. 9); notauli absent or vestigial, extending over no more than posterior 0.2 of mesoscutum (cf. ♀ – Fig. 19); eye height 1.0x as long as malar space; surface of eye with sparse hairs ..... *crassiclavis*
- Mesopleuron without such a sternaulus or carina (cf. ♀ – Fig. 18); apical antennomere at least 1.5x as long as preapical (Fig. 10); notauli extending over at least posterior 0.35 of mesoscutum (cf. ♀ – Fig. 20); eye height 2.3x as long as malar space; surface of eye without hairs ..... *formosus*

***Spilomicrus crassiclavis* Kieffer**

(Figs 2, 7–9, 17, 22)

*Spilomicrus crassiclavis* Kieffer, 1911: 788, 797. LECTOTYPE ♀, Great Britain: Mugdock (BMNH), here designated [examined]. **Stat. rev.** Lectotype labels: Mugdock, 11–7 [under mount]; Cameron coll., 1910–302; Mugdock; Determined by Dr. Kieffer.; *Spilomicrus crassiclavis* K.; *Spilomicrus formosus* Janss., G. Nixon det., 1972; B. M. TYPE HYM. 9.645a. Lectotype glued onto a card, with the right fore wing disarticulated, apical segment of left antenna lost and right hind telotarsus disarticulated.

[*Spilomicrus formosus* Jansson: Nixon, 1980: 16, Figs 30, 31. Misidentification in part (♀).]

*Spilomicrus pelion* Nixon, 1980: 17. Holotype♂, Great Britain: Surrey (BMNH) [examined]. **Syn. n.** Holotype labels: Holotype [red BMNH type label]; Surrey, Horsley, 14.vi.1930, G. Nixon; *Spilomicrus pelion* Nixon, Type♂, 197; B. M. TYPE HYM. 9.811. Holotype entire, mounted on a card point.

**DESCRIPTION.** ♀. Head (Fig. 2) in dorsal view 1.25–1.32x as wide as long; temples weakly to moderately contracted just behind eyes; dorsal part of occipital flange barely widened medially; post-genal pilosity sparse, not forming a defined cushion; head, in lateral view suboval, 1.13–1.17x as high as long; frons behind toruli weakly convex, almost flat; eye sparsely hairy; eye height 1.4–1.5x as long as malar space; in frontal view, apex of medial projection of clypeus triangular, pointed when seen from in front; lateral margins of clypeus undefined; malar sulcus a finely impressed line becoming a little deeper towards mandible. Antenna (Fig. 7): scape entirely smooth or at most weakly coriaceous at base; segment 3 about 2.5x as long as wide; segments 7–13 expanded to form a long-fusiform 7-segmented club; segments 8–12 strongly transverse; apical segment 1.49–1.74x as long as the preapical and slightly narrower than it; apical segment without a ventral pit. Mesosoma 1.29–1.37x as long as wide; anteriorly mesoscutum usually without a pair of short, submedial, parallel lines, rarely these are weakly indicated; notauli short but sharply incised, deep, weakly sinuate, narrowed anteriorly,

extending over posterior 0.18–0.24 of mesoscutum with no trace in front of this, convergent anteriorly (Fig. 19); humeral sulcus running 0.5–0.7 of the way from the transscutal suture to the posterior corner of pronotum; mesoscutum without other impressions; transscutal suture deeply incised; anterior scutellar pits subround, medial carina separating pits narrow; floor of anterior pits usually with one or two fine carinae running from front to back, rarely entirely smooth; lateral scutellar pits broad, deep, broadened posteriorly; posterior margin of scutellum with a row of 7–9, small, deep pits; dorsellum differentiated into dorsal and posterior faces, with three keels, which form three blunt projections dorsally; mesosoma slightly compressed laterally, 1.11–1.16× as high as wide; pronotum evenly concave between spiracle and pronotal shoulder; mesoscutum strongly convex; acetabular carina evenly curved across mesosternum and close behind fore coxae; sulcus just behind acetabular carina foveolate, with scattered pilosity; sternaulus absent; two to four deep foveolae just above the mid coxa and a weak flange immediately above the mid coxa; medial propodeal keel anteriorly forming a right-angled to acute, dorsally directed triangular projection. Fore wing with basal vein strongly pigmented and well defined; marginal vein 1.8–2.6× as long as wide; stigmal vein short, about as long as width of marginal vein; distal abscissa of radial sector moderately pigmented. Metasoma: dorsally visible part of petiole short, 1.3–1.5× as long as wide, longitudinal rugose, superimposed with weak coriaceous sculpture; in dorsal view, gaster short oval with apex obtusely pointed; metasomal syntergite (2+3) strongly convex, without micropunctures posteriorly; in lateral view metasomal tergites 7–8 almost perpendicular to long axis of gaster; metasomal sternite 2 without micropunctures, with two submedial tracts of hairs arising from fine punctures. Colour: mandibles dark brown to black; palps orange-yellow; radicle and basal 0.6–0.7 of scape black; apex of scape and antennal segments 2–6 orange-yellow, the more apical of these brownish; segments 7–13 black; tegulae orange-yellow; basal vein brown and marginal vein brown to dark brown; legs including coxae orange-yellow except for telotarsi and basal 0.6–0.7 of femora which are more or less darkened. Body length: 2.2–2.9 mm, fore wing length 2.00–2.46 mm.

♂. Differing from female as follows: Head in dorsal view 1.13–1.17× as wide as long; temples weakly contracted just behind eyes; head, in lateral view 1.08–1.22× as high as long; eye height 1.0× as long as malar space. Antenna (Fig. 9): scape mostly smooth, coriaceous as base; segments 3–13 cylindrical; third segment 2.1–2.5× as long as wide; segment 4 (Fig. 8) cylindrical, very slightly expanded apically, 2.6–2.8× as long as wide, about 1.2× as long as segment 3, weakly emarginate and with a low carina extending

over basal 0.7; preapical segment 1.6–1.7× as long as wide; apical segment no longer than and a little narrower than preapical. Mesosoma (Fig. 17) in dorsal view 1.46–1.52× as long as wide; notauli absent or represented by weak traces or at most represented by two small pits just in front of transscutal suture, extending over no more than posterior 0.2 of mesoscutum; humeral sulcus broad, running all the way from the transscutal suture to the posterior corner of the pronotum; mesoscutum sometimes with very shallow parapsidal impressions; posterior margin of scutellum with a row of 8–10 indistinct pits, which tend to coalesce; dorsellum less clearly differentiated into dorsal and posterior faces and with lateral keels indistinct; mesosoma depressed, 0.91–0.92× as high as wide; acetabular carina bowed posteriorly, almost reaching mid coxae; sternaulus present, defined dorsally by a strong carina which extends right across mesopleuron; mesopleuron with 3–4 rugae just above mid coxa. Fore wing with basal vein moderately pigmented; marginal vein 1.8–3.0× as long as wide; distal abscissa of radial sector weakly pigmented, almost spectral. Metasoma: dorsally visible part of petiole 1.3–2.2× as long as wide; in dorsal view, gaster oval, with apex rounded; in lateral view metasomal tergites 7–8 at about 45° to long axis of gaster; metasomal sternite 2 with medial area of micropunctures in apical half; metasomal syntergite (2+3) moderately convex with a small area of micropunctures posteriorly. Colour: mandibles dark brown to black; palps brown; antenna brown except for scape which has the basal 0.5–0.7 dark brown and apex orange to brown; tegulae brown; legs variable, orange to dark brown with coxae, base of tibiae and telotarsi darkened. Body length 2.1–3.7 mm; fore wing length 2.03–3.11 mm.

MATERIAL EXAMINED. **Czechia:** ♀, Bohemia, Šumava, Hurka v Pošum, 20.vii.1954 (*Hoffer*); ♂, Moravia, Javorina, 800–900 m, 10.viii.1991, climax eufagion for. (*Masner*) (CNC). **Denmark:** ♀, north-east Zealand, Færgelunden, 55°51'N 12°02'E, 21.vi.1988 (*Buhl*) (DN); ♂, north-east Zealand, Boserup Skov, 55°40'N 12°01'E, 12.vi.1988 (*Buhl*) (DN); ♂, 28.vi.1878 (*Schlick*) (ZM). **Finland:** ♀, Pohjois-Karjala, Tohmajärvi, 6908:660, 17.vii.1982 (*Koponen*) (SEL). **Great Britain:** ♀, Stirling, Mugdock, 11.vii.[pre-1910] (*Cameron*) (BMNH) (lectotype); ♀, W. Ross, Rassel National Nature Reserve, NG845432, 1–15.vi.1992, Malaise trap (*Brown*) (NMS); ♀, West Glamorgan, Crymlyn Bog, SS6995, 14.vi.1989 (*Holmes*) (DN); 3 ♀, Cheshire, Abbots Moss, SJ596680, 1–19.vi.1990, Malaise trap/swept (*Notton*) (DN); ♀, Cambridgeshire, Chippenham Fen, TL650693, 6.vii.1983, Malaise trap, carr/reed bed (*Field*) (DN); 2 ♀, Norfolk, Catfield, TG374204, 21.vi–5.vii.1988, water trap (DN); ♂, Surrey, Horsley,

14.vi.1930 (*Nixon*) (BMNH) (holotype); ♂, Kent, Eynsford, 7.vi.1930 (*Nixon*) (BMNH) (paratype). **Japan:** ♀, Iwate Prefecture, Mount Hayachie, 400 m, 19–26.vii.1989 (*Makihara & Sharkey*) (CNC). **Norway:** ♂, Røyken, Kinnertangen, EIS 28 BØ, vii.1993, Malaise trap (*Hansen*) (DN). **Sweden:** ♀, Närke, Örebro, 12.vii.1957 (*Jansson*) (ZI); ♀, Rörvik, Lammhult, 15.vii.1986 (*Buhl*) (ZM); ♀, Uppsala, Ericksburg, 14–17.vii.1986, pan trap (*Ronquist*) (CNC).

**DISTRIBUTION.** Widespread in north-west Europe including: Czechia, Denmark, Finland, Great Britain, Japan, Norway and Sweden (Fig. 22). Previously recorded from Britain (Kieffer, 1911; Nixon, 1980 as *Spilomicrus pelion*; Notton, 1996 as *S. near formosus*) and Algeria (Kieffer, 1911; cited in Jansson 1942). No evidence was found to support the occurrence of *S. crassiclavis* in Africa, the identity of the syntype material Kieffer recorded from Algeria is uncertain now that the type series has been found to be mixed.

**BIOLOGY.** Host unknown. Flight period June–July. Recorded mainly from woodland, fen habitats and other wetland.

**COMMENTS.** As well as the male syntype from Bishopton (Masner, 1965) a female syntype of *Spilomicrus crassiclavis* was discovered (BMNH) but the Algerian syntypic material collected by du Buysson is lost. Horn & Kahle (1937) note that the du Buysson collection is at the Muséum National d'Histoire Naturelle, Paris but this material could not be found there (Claire Villemant, pers. com.). Since the two syntypes located are considered to belong to different species the female was chosen as a lectotype. The previous synonymy established by Nixon (1980) of *S. crassiclavis* is not supported by this designation and so *S. crassiclavis* is removed from synonymy with *S. integer*. Also *S. pelion* is here synonymised with *S. crassiclavis*. Character states associating the sexes include the following: shorter antennal segments, shorter notauli, less bulging temples and generally smaller size than for *S. formosus*. A re-examination of the material seen by Nixon (1980) showed that the female he referred to as *S. formosus* was in fact *S. crassiclavis*. Teodorescu (1970; 1986) figured the male genitalia, however, owing to the taxonomic problems outlined above, the identity of this material is doubtful.

### *Spilomicrus formosus* Jansson

(Figs 3–4, 10–12, 18, 20–21)

*Spilomicrus formosus* Jansson, 1942: 215.  
LECTOTYPE ♀, Sweden: Örebro, Oset (ZI), here designated [examined]. Lectotype labels: Ö. Oset, 10–8 39 A. J.; Typus [red label]; *Spilomicrus*

*formosus* Janss., ♀; Zool. Mus. Lund Sweden, Diapriidae Type No. 1411:1–7; ZML 1997.026. Lectotype entire, clean and glued onto a card with its wings raised.

**DESCRIPTION.** ♀. Head (Fig. 3) in dorsal view 1.36–1.42× as wide as long; temples weakly expanded to parallel just behind eyes; dorsal part of occipital flange widened medially; post-genal pilosity sparse, not forming a defined cushion; head, in lateral view suboval, 1.04–1.20× as high as long; frons behind toruli weakly convex, almost flat; eye sparsely hairy; eye height 1.7–2.2× as long as malar space; apex of medial projection of clypeus triangular, pointed when seen from in front; lateral margins of clypeus undefined; malar space a finely impressed line, becoming a little deeper towards mandible. Antenna (Fig. 10) slender; scape entirely smooth or at most weakly coriaceous at extreme base of dorsum; segment 3 about 3.5× as long as wide; segments 7–13 expanded to form a long, cylindrical, 8-segmented club; segments 8–12 quadrate to slightly elongate; apical segment 1.7–1.8× as long as the preapical and as wide or very slightly narrower than it; apical segment without a ventral pit. Mesosoma (Fig. 18) short, 1.25–1.26× as long as wide; anteriorly mesoscutum usually without a pair of short, submedial, parallel lines, rarely these are weakly indicated; notauli sharply incised, deep, weakly sinuate, narrowed anteriorly, extending over posterior 0.35–0.45 of mesoscutum with no trace in front of this, divergent anteriorly (Fig. 20); humeral sulcus running all the way from the transscutal suture to posterior corner of pronotum; mesoscutum without other impressions; transscutal suture deeply incised; anterior scutellar pits subround, medial carina separating pits narrow; floor of anterior pits smooth; lateral scutellar pits broad, deep, broadened posteriorly; posterior margin of scutellum with a row of 7–9 small, deep pits; dorsellum differentiated into dorsal and posterior faces, with three keels which project dorsally as three, sharp points; mesosoma slightly depressed, 0.90–0.93× as high as wide; pronotum evenly and shallowly concave between spiracle and pronotal shoulder; mesoscutum strongly convex; acetabular carina evenly curved across mesosternum and close behind fore coxae; sulcus just behind acetabular carina foveolate with scattered pilosity; sternaulus absent; four to five deep foveolae just above mid coxa and a broad flange immediately above mid coxa; medial propodeal keel anteriorly forming a right-angled to acute, dorsally directed, triangular projection. Fore wing with basal vein strongly pigmented and well defined; marginal vein 2.0–2.3× as long as wide; stigmal vein short, about as long as width of marginal vein; distal abscissa of radial sector moderately pigmented. Metasoma: dorsally visible part of petiole short, 1.2–1.4× as long as wide, longitudinally rugose superimposed with weak

coriaceous sculpture; in dorsal view, gaster short oval, with apex obtusely pointed; metasomal syntergite (2+3) strongly convex, without micropunctures posteriorly; in lateral view metasomal tergites 7–8 almost perpendicular to long axis of gaster; metasomal sternite 2 without micropunctures, with two submedial tracts of hairs arising from large punctures. Colour: mandibles dark brown to black; palps orange-yellow; antennal segments 1–5 orange-yellow except for the radicle which is black and basal 0.2 of scape which is occasionally black as well; segment 6 brown and segments 7–13 usually black; rarely the sixth orange-yellow and seventh dark brown; tegulae transparent, orange-yellow; fore wing with basal vein brown and marginal vein brown to dark brown; legs including coxae orange-yellow. Body length 2.2–3.1 mm; fore wing length 2.70–2.86 mm.

♂. Differing from female as follows: head (Fig. 4) in dorsal view 1.35–1.39× as wide as long; head, in lateral view, 1.11–1.20× as high as long; eye height 2.3× malar space; eye without hairs. Antenna (Fig. 12): segments 3–13 cylindrical; third segment 3.5–3.7× as long as wide; fourth segment 3.4–3.6× as long as wide and as long as segment 3; segment 4 cylindrical, with at most a weak basal emargination and a low, weak carina in basal 0.3–0.4 (Fig. 11); preapical segment 2.0–2.1× as long as wide; apical segment 1.5–1.6× as long as wide as the preapical and a little narrower than it. Mesosoma in dorsal view 1.31–1.35× as long as wide; notauli extending over posterior 0.3–0.4 of mesoscutum; posterior margin of scutellum with a row of 9–12 small deep pits; dorsellum with keels usually projecting dorsally as sharp points but sometimes rounded; mesosoma slightly depressed to slightly compressed, 0.98–1.15× as high as wide. Fore wing: marginal vein 1.7–2.2× as long as wide. Metasoma: dorsally visible part of petiole 1.3–1.5× as long as wide; gaster short oval, its apex rounded; in lateral view metasomal tergites 7–8 at about 45° to long axis of gaster. Colour: mandibles black to dark brown; palps orange-yellow to brown; antennal colour variable, in lightest individuals, scape orange yellow with basal third black, pedicel orange-yellow and flagellum brown, in darkest individuals, scape all black, pedicel dark brown and flagellum black; tegulae transparent orange-yellow; legs with ground colour varying from orange-yellow to brown; telotarsi and basal 0.5–0.65 of femora blackened and coxae and trochanters brown. Body length 2.8–3.4 mm; fore wing length 2.71–3.20 mm.

**MATERIAL EXAMINED.** **Belgium:** ♂, Mont Rigi, stat. se. Hautes Fagnes, 18–24.viii.1983, Université Liège (CNC). **Czechia:** ♀, Moravia, Lednice, env., 7–9.viii.1991, yellow pan trap, riparian forest (*Masner*); ♂, Bohemia C., Řevnice (*Masner*) (CNC). **Denmark:** 2 ♀, ♂, north Zealand, iv.1891, each

mounted with a pipunculid puparium (*Schlick*) (ZM); ♂, v.1889; 4 ♀, 2 ♂, iv.1890, each mounted with a pipunculid puparium (*Schlick*) (ZM); ♀, Zealand, Ruderhegen, v.1910, ex. *Pipunculus* sp., mounted with a pipunculid puparium (*Kryger*) (CNC). **Finland:** ♀, Uusimaa, Espoo, 6669:373, 27.viii.1982 (*Koponen*) (SEL); ♀, Kemin Lappi, Kittilä, 7469:409, 17.viii.1983 (*Koponen*) (DN); ♂, Etelä-Savo, Mäntyharju, 6795:508, 1.viii.1981 (*Koponen*) (SEL); ♂, Etelä-Pohjanmaa, Töysä, 6948:336, 23.vii.1987 (*Koponen*) (SEL); ♂, Helsinki, 28.vi–11.vii.1989, Malaise trap (*Goulet*) (CNC). **Germany:** 3 ♂, Bayern, Oberstdorf, 12–29.viii.1936 (*Nixon*) (BMNH). **Great Britain:** 2 ♂, Elgin, Aviemore, 26.vii & 5.viii.1946 (*Harwood*) (BMNH); ♀, 2 ♂, W. Ross, Rassel National Nature Reserve, NG845432, x.1991, Malaise trap (*Brown*) (DN); 2 ♀, Cambridgeshire, Chippenham Fen, TL6469, 17–24.vi.1985, Malaise trap (*Field*) (DN); ♂, Chippenham Fen, TL650693, 6–20.vii.1985, Malaise trap (*Field*) (DN); ♂, Pembrokeshire, Brynberian Moor, SN106346, 20.vii.1987, pitfall trap, *Juncus* sp., soligenous flush (*Holmes*) (DN); ♂, Wiltshire, Savernake Forest, SU21366708, 26.vii–16.viii.1990, Malaise trap (DN); ♂, Oxfordshire, Weston Fen, SP526194, 22.vii–20.viii.1987, Malaise trap (DN); ♂, Surrey, Oxshott, 9.viii.1930 (*Nixon*) (BMNH). **Ireland:** ♂, Co. Wexford, Benroe, Killybegs district, 18.viii.1933 (*Stelfox*) (BMNH). **Japan:** 2 ♂, Hokkaido, Tomuraushi area, 500 m, 13.viii.1996 (*Masner*) (CNC). **Norway:** 2 ♀, ♂, Bærum, Kjaglidalen, EIS 28 AK, 27.vii–11.viii.1990, Malaise trap (*Falck*) (DN); ♂, Rollag, Vårviken, EIS 35 BV, viii.1992, Malaise trap (*Sagvolden*) (DN). **Russia:** ♀, Moscow, Bitsa Park, 18.viii.1993 (*Kolyada*) (RAS); ♂, Moscow, 13.vii.1993 (*Kolyada*) (RAS). **Slovakia:** ♂, {illegible}, Nizké Tatry, Kysla, 10.viii.1989 (*Macek*) (CNC). **Sweden:** ♂, Blekinge, Rödeby Gagnekulla, 56°16'N 15°34'E, 8.ix.1956 (*Sundholm*) (ZI); ♀, 2 ♂, Dalarna, Äl, 10 km south east of Leksand, 60°42'N, 15°02'E, 4.viii.1968 (*Sundholm*) (ZI); 3 ♂, Dalarna, Järna, 60°33'N, 14°15'E, 3.viii.1968 (*Sundholm*) (ZI); 2 ♀, Hälsingland, Loos, pre-1942 (*Sjöberg*) (ZI) (paralectotype); 5 ♂, Jämtland, Fors, 63°01'N, 16°37'E, 7.viii.1964 (*Sundholm*) (ZI); ♂, Lulelappmark, Jokkmokk Messaure, 66°43'N, 20°20'E, 7.viii.1966 (*Sundholm*) (ZI); ♀, Närke, Örebro, Oset, 59°17'N, 15°10'E, 10.viii.1939 (*Jansson*) (ZI) (lectotype); ♂, Närke, Örebro, Oset, 59°17'N, 15°10'E, 17.viii.1944 (*Jansson*) (ZI); ♀, Närke, Örebro, Ö. Mark, 59°15'N, 15°12'E, 20.viii.1944 (*Jansson*) (ZI); ♂, Närke, Örebro, 22.viii.1937 (*Jansson*) (ZI) (paralectotype); ♀, Närke, Örebro, 20.viii.1939 (*Jansson*) (ZI) (paralectotype); ♀, Närke, Örebro, 16.viii.1941 (*Jansson*) (ZI) (paralectotype); 2 ♀, 11 ♂, Närke, Örebro, 28.vii.1941–20.vii.1960 (*Jansson*) (ZI); ♂, Närke,

15.viii.1955 (*Sundholm*) (ZI); ♂, Norrbotten, Edefors, 66°05'N, 20°54'E, 31.vii.1958 (*Sundholm*) (ZI); ♂, Norrbotten, Nedertorneå, 65°50'N, 24°07'E, 24.vii.1966 (*Sundholm*) (ZI); ♀, Nu., 15.viii.1955 (*Jansson*) (ZI); ♂, Öland, Gårdby, 56°37'N, 16°05'E, 7.viii.1967 (*Sundholm*) (ZI); ♂, Östergötland, Skedevi, 58°08'N, 15°42'E, 2.viii.1970 (*Sundholm*) (ZI); ♂, Skåne, Skaralid, 16.vii.1937 (*Jansson*) (ZI) (paralectotype); 3♂, Skåne, Yngsjö, 55°57'N, 14°11'E, 23.vii.1964 (*Sundholm*) (ZI); ♂, Småland, Halltorp Värnanäs, 56°30'N, 16°07'E, 8.viii.1967 (*Sundholm*) (ZI); ♂, Småland, 20.ii.1943 (*Jansson*) (ZI); 5♂, Södermanland, Dalarö, Malmen, viii.1976 (BMNH); ♂, Södermanland, Länna, 10 km south of Strängnäs, 59°18'N, 16°54'E, 9.viii.1958 (*Sundholm*) (ZI); ♂, 24.vii.1940 (ZI); ♀, 25.vii.1943 (ZI); ♂, 1.viii.1944 (*Jansson*) (ZI). **Canada:** ♀, ♂, British Columbia, Hollyburn, 24.viii.1930 (*Whittaker*) (BMNH). **U.S.A.:** ♂, Washington, Okanagan C., N. Waconde, 25.vii.1985 (*Tinnamore*) (BMNH); ♀, Virginia, Shenandoah N. P., Big Meadow, 1,300 m, vii–viii.1987, Malaise trap, natural meadow (*BRC Hym. Team*) (BMNH).

**DISTRIBUTION.** Widespread in north-west Europe, extending well inside the Arctic circle (Fig. 21) including: Belgium, Czechia, Denmark, Finland, Germany, Great Britain, Ireland, Norway, Russia, Slovakia and Sweden, also occurring in Japan, Canada and the U.S.A. Previously recorded from Czechia (Masner, 1991), Denmark (Masner, 1991), Finland (Hellén, 1963; Masner, 1991), Germany (Nixon, 1980), Great Britain (Nixon, 1980 – males only), Russia (Hellén, 1963), Slovakia (Masner, 1991) and Sweden (Masner, 1991).

**BIOLOGY.** Eleven Danish specimens of *S. formosus* were seen each mounted with the puparium of a pipunculid (Diptera). Of these Kryger's specimen was identified as *Pipunculus* sp., supporting Masner's (1991) observation that this genus is attacked in Europe. The developmental stage of host attacked is unknown, although by analogy with other *Spilomicrus*, it is likely that oviposition is into the young host puparium. This would necessarily be after the pipunculid has emerged from its own cicadellid (Homoptera) host, and is therefore likely to be a case of pseudohyperparasitism *sensu* Shaw & Askew (1976). There are no host records yet from the Nearctic. In Europe both sexes are found most often from July to August, with a few females also in June, the dates of reared Danish material, April to May, may not be representative as they are much earlier and these wasps may have been reared indoors in warmer conditions than would be natural. In Europe *S. formosus* is recorded from a range of habitats including fen and other wetland, forest and grassland. This is very similar to its behaviour in north America where the flight period

is from July to October and it frequents mainly forest habitats (Masner, 1991).

**COMMENTS.** Nixon (1980) misinterpreted the female of *S. formosus* although he correctly identified the male. The single female he mentioned belongs to *S. crassiclavis* q. v. One male *S. formosus* from Örebro, dated 28.vii.1941 (ZI), is erroneously labelled 'typus'; its date is not among those given in the original description and so it was not considered a syntype. Hellén's (1963) material of this species is thought to be at the Museum of Helsinki University but is apparently lost.

### *Spilomicrus sanbornei* Masner 1991

(Figs 5–6, 13–16, 23)

*Spilomicrus sanbornei* Masner 1991: 145. Holotype ♀, Canada: Ontario, Thunder Bay (CNC) [not examined].

**DESCRIPTION.** ♀. Head (Figs 5–6) in dorsal view 1.12–1.17× as long as wide; dorsal part of occipital flange of even width; post-genal pilosity, forming only a small cushion; temples parallel just behind eyes; head in lateral view very rounded, subcircular 1.00–1.05× as high as long; frons convex; vertex evenly rounded; eye sparsely hairy, small, its height 1.6–1.8× as long as malar space; apex of medial projection of clypeus rounded when seen from in front; malar sulcus, narrow near eye and distinctly widened towards mandible, where it has the form of a step rather than a groove, so that the anterior gena is depressed relative to the posterior gena; lateral margin of clypeus defined by a deep groove. Antenna (Fig. 13) robust: scape smooth dorsally, weakly coriaceous ventrally; segment 3 about 1.7× as long as wide; segment 8 slightly expanded and segments 9–13 strongly expanded to form a short-fusiform 5- to sub-6-segmented club; segments 8–12 weakly to strongly transverse; apical segment 1.0–1.1× as long as the preapical and only 0.85× as wide as it; apical segment with a large, shallow, ventral pit. Mesosoma (Fig. 16) in dorsal view 1.45–1.54× as long as wide; notauli deeply impressed over posterior 0.30–0.45 of mesoscutum, indicated as a shallow trace for a short distance in front of this; anteriorly mesoscutum with a pair of short, submedial, parallel lines usually distinct but sometimes weak or absent; mesoscutum with a slight impression in front of each hind corner of the mesoscutum; humeral sulcus fine, running all the way from the transscutal suture to the posterior corner of the pronotum; transscutal suture moderately incised becoming weaker laterally; anterior scutellar pits deep, oblique oval, the medial carina separating the two pits usually narrow but sometimes a little wider; floor of anterior pits with fine carinae running from front to back; lateral scutellar pits usually deep and slightly



broadened posteriorly but shallower in specimens with a more depressed mesosoma; posterior margin of scutellum with a row of 9–12 small pits; dorsellum rounded, not differentiated into dorsal and posterior faces, its keels weakly developed, the lateral keels vestigial, the medial keel rounded, only weakly projecting dorsally; mesosoma strongly depressed, 0.73–0.77× as high as wide; pronotum with a shallow but distinct fovea between spiracle and pronotal shoulder; mesoscutum only weakly convex, flattened dorsally; sulcus just behind acetabular carina not foveolate, almost glabrous; sternaulus absent; area above middle coxa with only a few rugae; medial propodeal keel low, hardly raised in front. Fore wing with basal vein moderately pigmented; marginal vein 2.1× as long as wide; stigmal vein very short, about half as long as width of marginal vein; distal abscissa of radial sector barely pigmented, almost spectral. Metasoma with dorsally visible part of petiole short, 1.4× as long as wide with 3–6 strong, almost parallel, longitudinal keels; in dorsal view gaster elongate oval, its apex pointed, approximately right-angled; metasomal syntergite (2+3) weakly convex, with area of micropunctures postero-medially; in lateral view, metasomal tergites 7 to 8 at about 45° to long axis of gaster; metasomal sternite 2 without micropunctures, with sparse, scattered hairs arising from fine punctures. Colour: antennal segments 1–8, palps and legs including coxae orange yellow, telotarsi more or less darkened; antennal club shading from brown to dark brown or black; mandibles and tegulae brown. Body length: 1.9–2.5 mm; fore wing length 1.51–1.80 mm.

♂. Differing from female as follows: head in dorsal view 1.18–1.25× as long as wide; temples parallel to very slightly receding just behind eyes; head in lateral view 1.03–1.07 as high as long; eye height 2.1 as long as malar space. Antenna (Fig. 15) with flagellar segments cylindrical; flagellum slightly narrowed apically and basally; third segment 2.2–2.5× as long as wide; fourth segment 2.2–2.4× as long as wide and about 1.1× as long as segment 3; emargination of segment 4 moderately deep, curved, with a low carina over basal 0.45–0.5, ending in a small tooth (Fig. 14); preapical segment 1.6–1.7× as long as wide; apical segment 1.3–1.4× as long as preapical and barely narrower than it; apical segment without a ventral pit. Mesosoma in dorsal view 1.34–1.43× as long as wide; notauli deeply impressed over posterior 0.25–0.45 of mesoscutum; mesosoma strongly depressed, 0.76–0.79× as long as high; marginal vein 1.8–2.2× as long as wide. Metasoma with dorsally visible part of petiole short, 1.2–1.4× as long as wide; in dorsal view gaster with apex rounded. Colour: antennal scape varying from orange-yellow to brown, pedicel orange-yellow; flagellum orange-yellow to yellow brown, usually darkened apically; palps yellow; legs, including coxae, orange-yellow with coxae, femoral clubs, tibial clubs

and telotarsi more or less darkened. Body length: 2.0–2.3 mm; fore wing length 1.84–1.96 mm.

**MATERIAL EXAMINED.** **Great Britain:** ♂, Cheshire, Abbots Moss, SJ596680, 1–19.6.1990, Malaise trap (*Notton*) (NMS); ♀, ♂, Cheshire, Abbots Moss, SJ596680, 19.6–10.7.1990, Malaise trap (*Notton*) (DN). **Canada:** ♀, Ontario, Guelph, 8–24.vi.1981, pan trap (*Barber*) (CNC) (paratype); ♂, Ontario, Rondeau Prov. Pk, 9–26.vi.1980, interception trap (*Goulet*) (CNC) (paratype); ♂, Quebec, Gatineau Pk, 28.vi–5.vii.1983, beaver pond, interception trap (*Denis*) (CNC) (paratype); ♀, Quebec, Old Chelsea, 5–15.vi.1987, NCC woodpile, pan trap (*Masner*) (CNC) (paratype); ♂, Québec, Old Chelsea, 5–15.vi.1987, pan trap in dead wood pile (*Masner*) (BMNH) (paratype).

**DISTRIBUTION.** Newly recorded from Britain and the Palaearctic (Fig. 23). Previously recorded from the Nearctic including Canada and the United States (Masner, 1991).

**BIOLOGY.** Host unknown. In both North America and Britain the flight period is June to July and forest habitats are frequented.

**COMMENTS.** *Spilomicrus sanbornei* is superficially similar in appearance to *S. abnormis* but easily distinguished from it by the presence of a malar sulcus, lack of pubescence at the base of metasomal syntergite (2+3). British material of *S. sanbornei* does not encompass the full range of variation shown by Nearctic material in the length of the notauli, sculpture of the floor of the basal scutellar pits and body length. This is probably because few British specimens were examined. British material also has the anterior parallel lines of the mesoscutum either absent or less well developed than in Nearctic specimens and the mesosoma very slightly more depressed. This is not considered significant because such variation in these features of the mesosoma is common in diapriines, particularly in groups where wing reduction is frequent.

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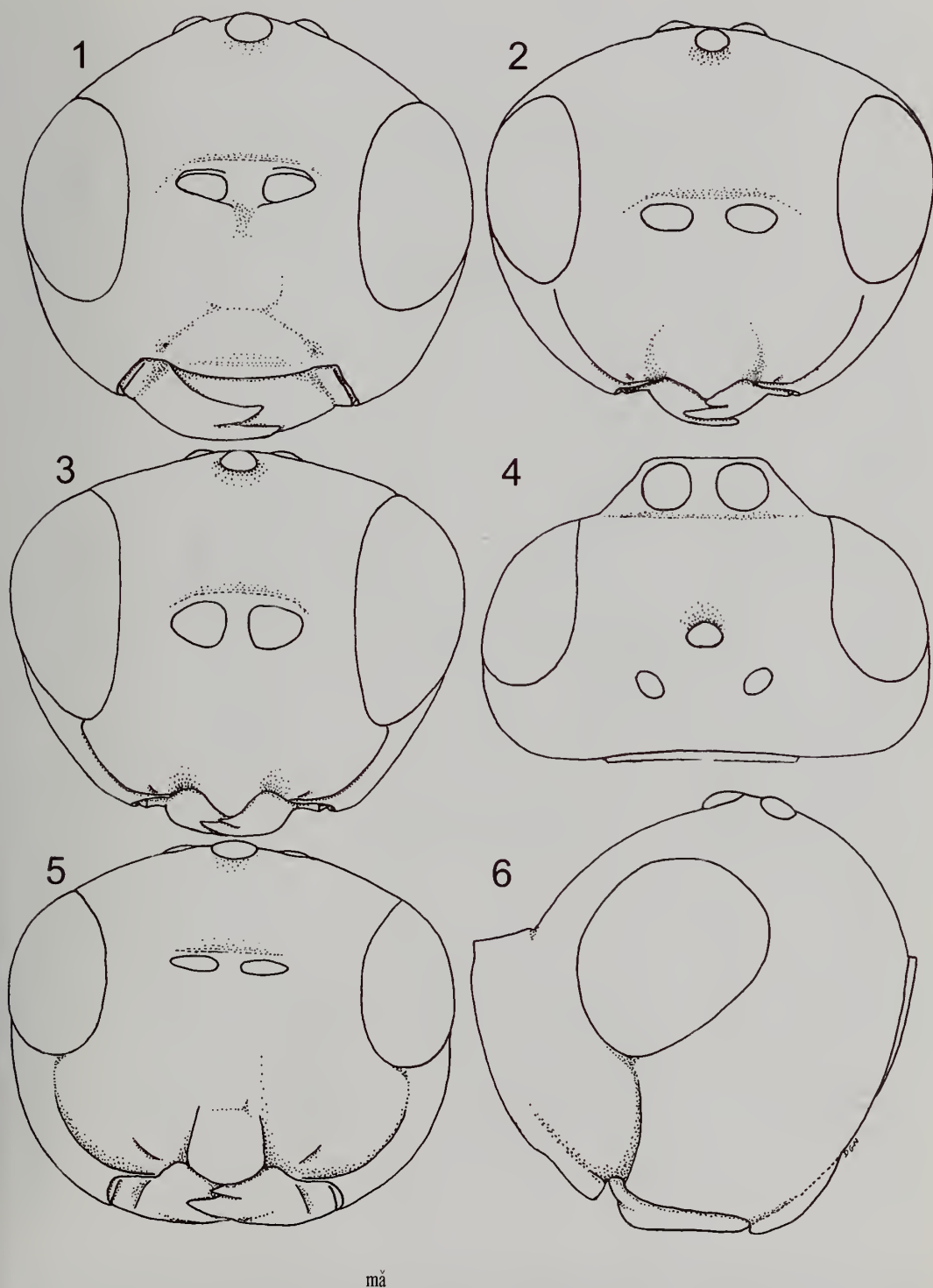
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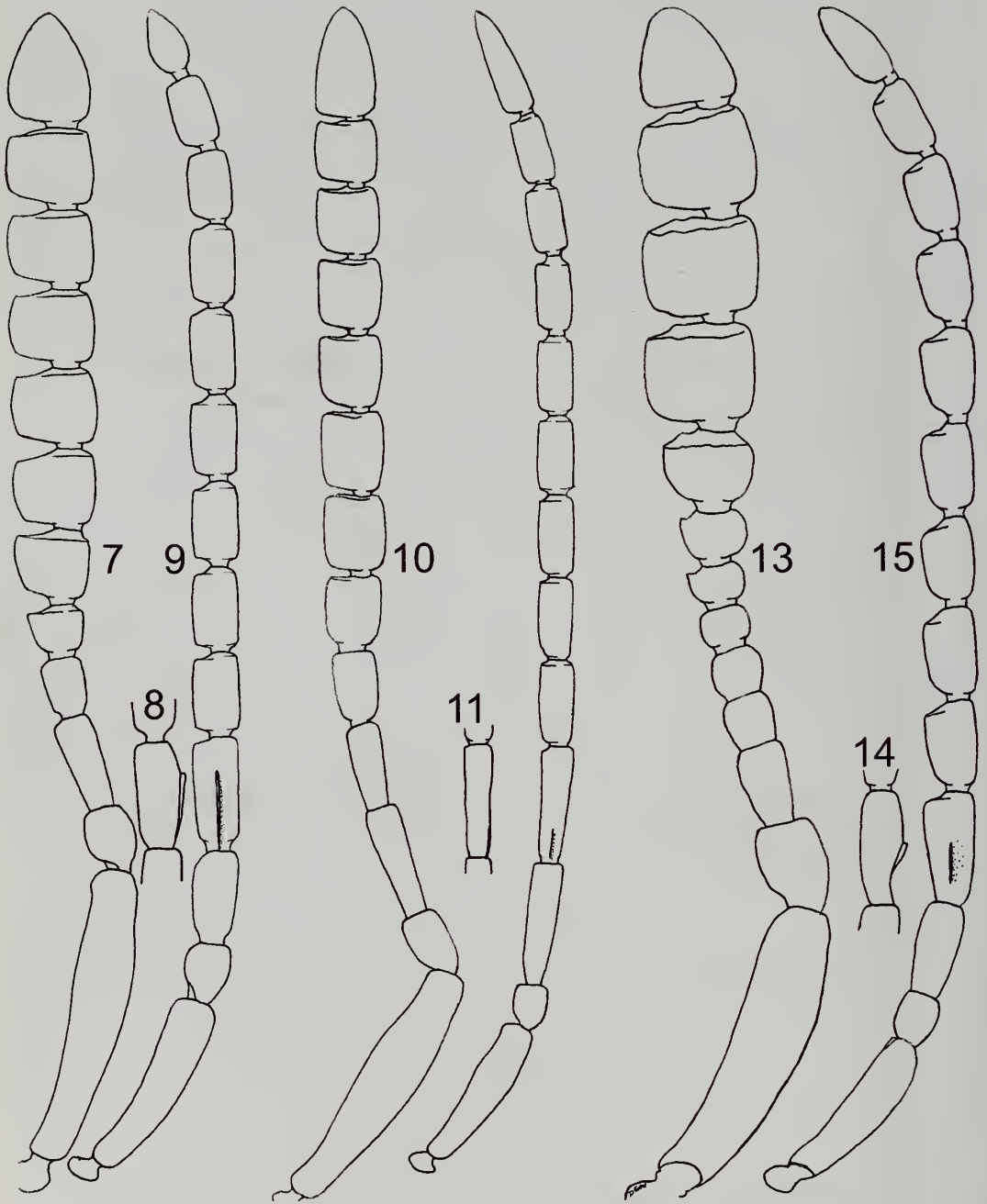
Synonyms and misidentifications are in *italics*; principle references are in **bold**.

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Fig. 1. *Spilomicrus stigmatalis* – head, anterior, ♂. Fig. 2. *S. crassiclavis* – head, anterior, ♀. Figs 3–4. *S. formosus* – 3, head, anterior, ♀; 4, head, dorsal, ♂. Figs 5–6. *S. sanbornei* – 5, head, anterior, paratype ♀; 6, head, lateral, paratype ♀.

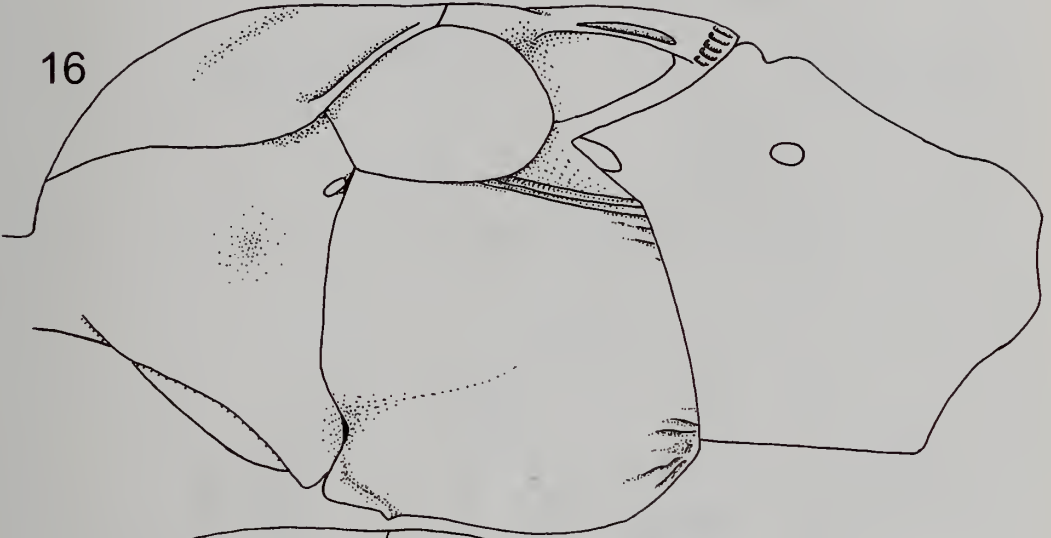


Figs 7-9. *Spilomicrus crassiclavis* - 7, left antenna, posterior, ♀; 8, left antenna, fourth segment, posterior, ♂; 9, left antenna, posterior ♂.

Figs 10-12. *S. formosus* - 10, left antenna, posterior ♀; 11, left antenna, fourth segment, posterior, ♂; 12, left antenna, posterior, ♂.

Figs 13-15. *S. sanbornei* - 13, left antenna, posterior, paratype ♀; 14, left antenna, fourth segment, posterior, paratype ♂; 15, left antenna, posterior, paratype ♂.

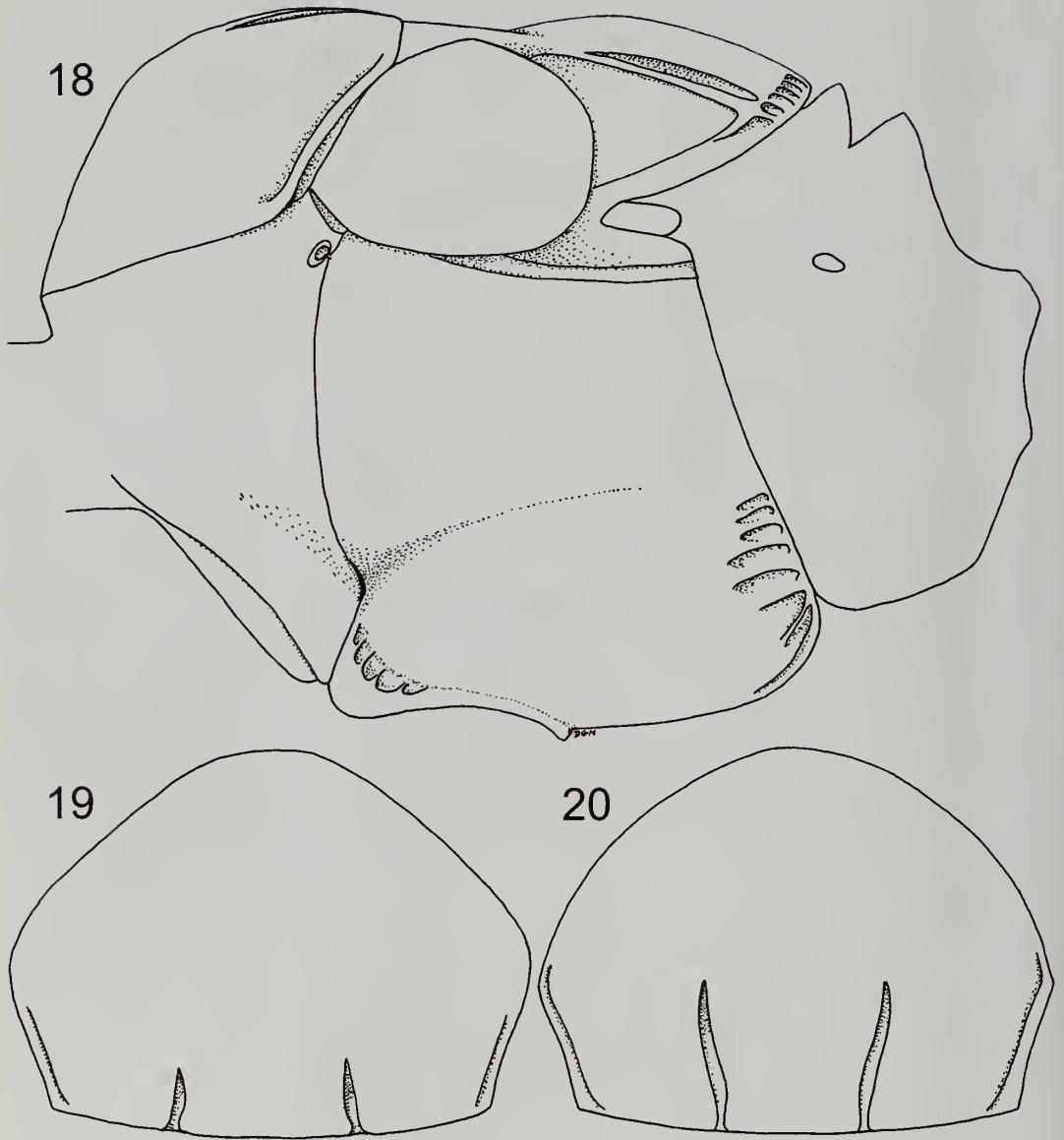
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Fig. 16. *Spilomicrus sanbornei* – mesosoma, lateral, paratype ♀. Fig. 17. *S. crassiclavis* – mesosoma, lateral, ♂.



Figs 18 & 20. *Spilomicrus formosus* – 18, mesosoma, lateral, ♀; 20, mesoscutum, dorsal, ♀. Fig. 19. *S. crassiclavus* – mesoscutum, dorsal, ♀.

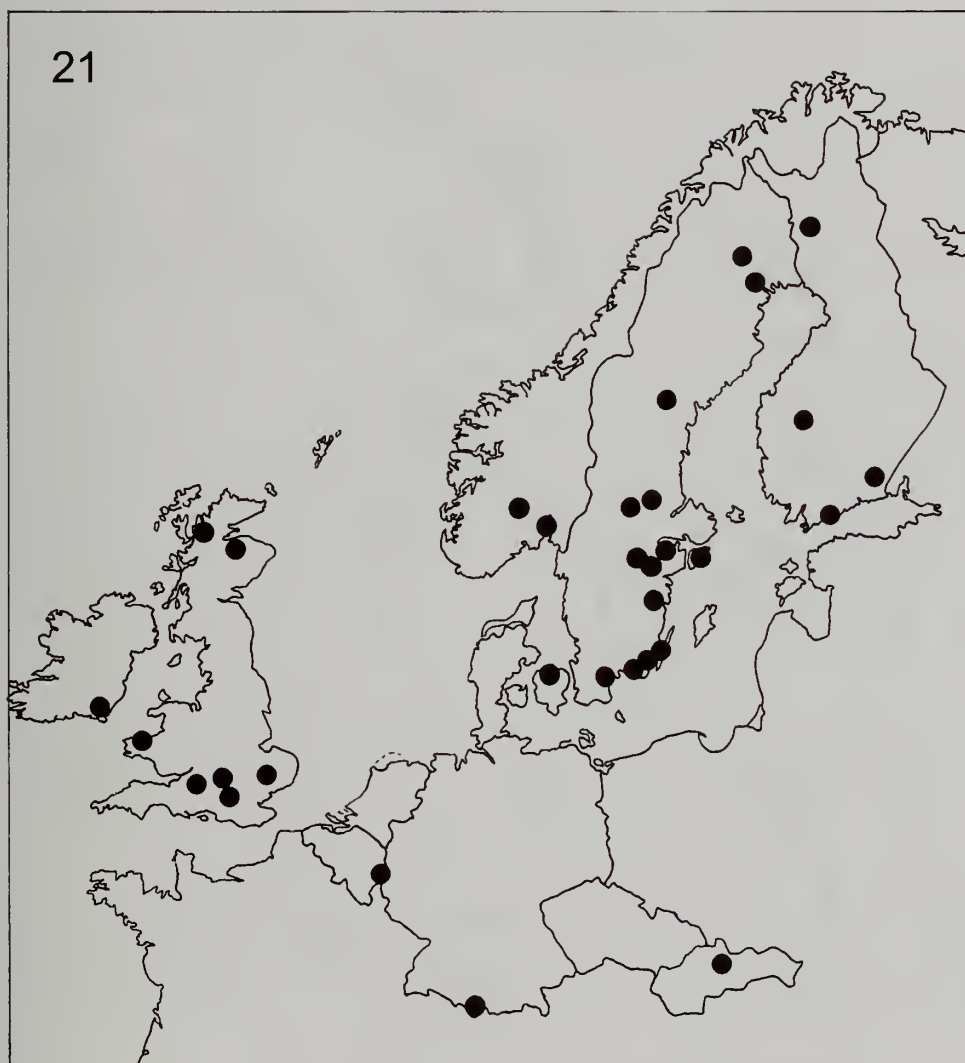


Fig. 21. *Spilomicrus formosus* – North-west European distribution.

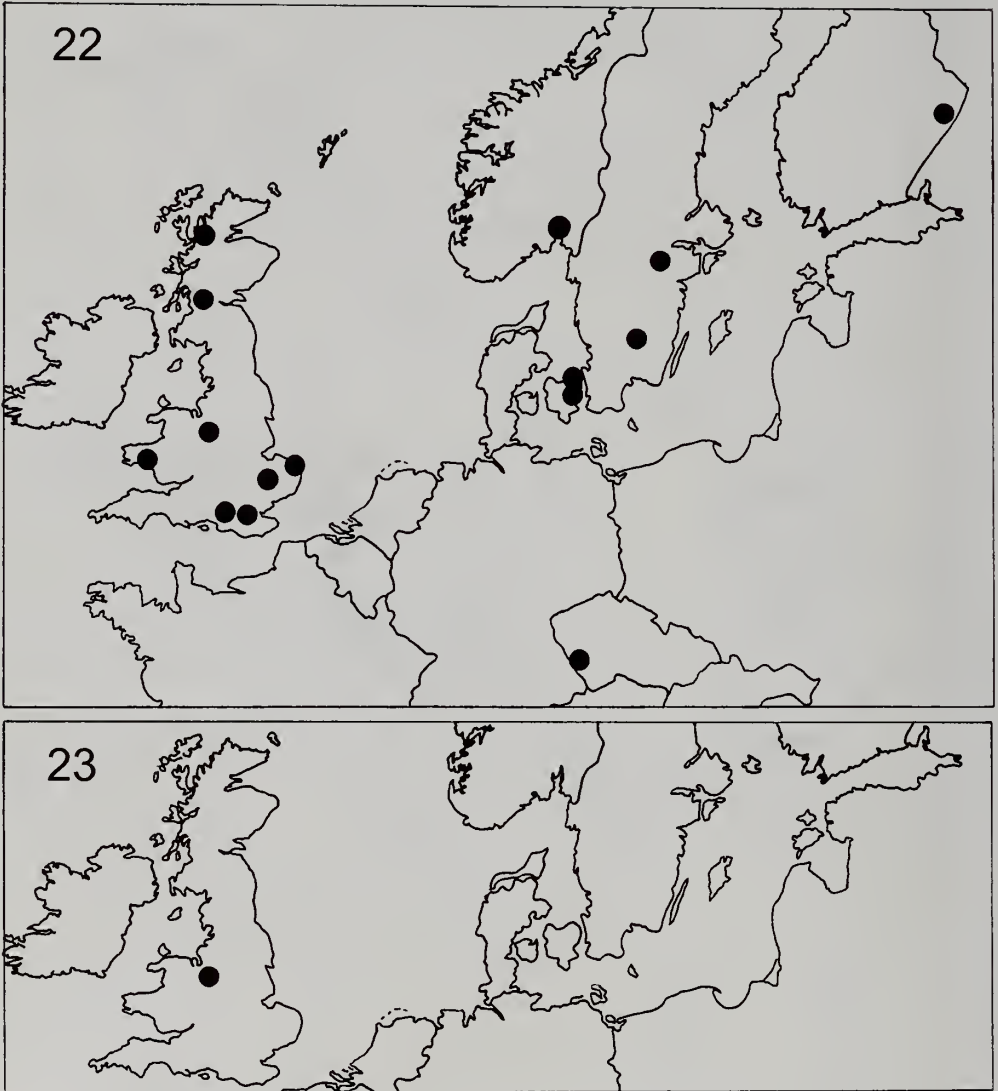


Fig. 22. *Spilomicrus crassiclavis* – distribution. Fig. 23. *S. sanbornei* – North-west European distribution.